THE RELATIONSHIP BETWEEN READING AND SUCCESSFUL NINTH GRADE MATHEMATICS ACHIEVEMENT

by

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INTRODUCTION

Modern mathematics has been replacing traditional mathematics in the curriculums of many schools during the decade of the sixties. Being a rather significant change, the new mathematics programs have caused many questions to be raised. There has been some concern about graduating students of modern mathematics who are devoid of computational skills. This concern has been raised about modern mathematics programs by parents, teachers, administrators, and some of the early leaders connected with modern mathematics programs. In fact, Beberman stated, "We are in danger of raising a generation of kids who can not do computational arithmetic."[1]

In addition, the writers of modern textbooks in mathematics have spent much time and effort on vocabulary and language. The modern textbooks contain an increased amount of reading coupled with a more sophisticated language. These two factors have caused reading difficulties for many students at all grade levels in the public schools.

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[1]Max Beberman, "The Trials of New Math," Time, 85:36, January 22, 1965.

Background

The writer was teaching in one of the junior high schools in the Wichita Public School System when the change to a modern mathematics textbook was made. After having used the Laidlaw Modern Mathematics Series for the past four years, the writer and several colleagues noted that this series stressed reading to a greater extent than had traditional textbooks. With increased emphasis on reading, it was apparent that reading problems unique to mathematics would arise.

The expected difficulties soon became apparent. As the students progressed through the textbooks, they frequently failed to see the concepts due to detailed printed explanations. As time passed, it was the reading in the textbooks that caused the difficulty, not the mathematical concepts. In fact, many teachers were forced to read the textbook to the students because the students could not comprehend the reading material. This situation occurred in grades seven, eight, and nine.

In addition, the need for special reading skills unique to mathematics became all too apparent. Reading always has been necessary to understand mathematics, but as Aaron[1] has stated, there are certain specialized

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[1] I. E. Aaron, "Reading in Mathematics," Journal of Reading, 8:331-35, May, 1965.

reading skills and understandings that are the responsibility of the mathematics teacher. He suggested the following: (1) developing the mathematical vocabulary, (2) developing the necessary background to understand new concepts, (3) developing the ability to select appropriate techniques for reading mathematics materials, (4) developing proficiency in the special reading tasks in mathematics, (5) developing skill in interpreting mathematical symbols and abbreviations, and (6) helping the excellent as well as the poor readers in mathematics.

Statement of Problem

The problem of this study was to determine the effect of reading on successful mathematics achievement. To study this problem, the following specific questions were asked:

1. Was there any relationship between mathematics and reading scores as indicated on the PREP test?

2. What was the nature of the relationship among the following factors:

a) teacher grades in mathematics and the PREP mathematics score?

b) teacher grades in mathematics and the PREP reading score?

c) teacher grades in mathematics and the PREP composite score?

3. Was there any interaction among these factors:

a) sex of the student and PREP mathematics score?

b) sex of the student and PREP reading score?

c) sex of the student and PREP composite score?

4. Was there any interaction among the reading, mathematics, and composite scores?

Limitations of Study

This study involved only one junior high school in the Wichita public schools which made the study very localized.

Within the framework of this limitation, other factors imposed limitations as well. The constituents of the school district were of the lower-middle socio-economic class. In many cases the home offered very little encouragement for the students. Thus, the population for this study was somewhat unique.

Since the study was conducted only at the ninth grade level, the results of the study will apply to the one grade level, not the entire school.

Finally, the test which was used placed limitations on the study. The mathematics students had completed three years of modern mathematics instruction. The test used included questions of a more traditional

nature. Therefore, students were unable to answer some of the test items due to differences in terminology and background.

Definitions of Terms

Modern mathematics programs. Modern mathematics programs are those that have evolved in the past ten years as a result of such groups as the School Mathematics Study Group, the University of Illinois Committee on School Mathematics, Maryland Study, NCTM, and the Commission on Mathematics of the CEEB.

Achievement test. An achievement test measures the amount a student has achieved in one or more subject fields.

Test battery. A test battery includes a group of tests of which the results are of importance individually, in combination, and in their entirety.

Factor analysis. Factor analysis is a method of analyzing the intercorrelations among a set of variables such as test scores.

Teacher grade. The final letter grade A, B, C, D, or F issued by the teacher as an indication of the student's degree of success in the course is considered to be the teacher grade.

PREP. PREP is an abbreviation for Pupil Record of Educational Progress, an achievement test battery

developed by Science Research Associates.

REVIEW OF LITERATURE

The concern of teachers in mathematics with regard to reading ability is not unique to modern mathematics. Teachers recognized reading as a factor in mathematics achievement before the modern programs came into existence. The problem of reading in mathematics has become more acute in the programs defined as modern mathematics. This is due in part to the increased amount of reading which is characteristic of modern mathematics programs. It is further accentuated by the more exact, as well as sophisticated, language used in the writing of modern textbooks.

Readability of Mathematics Materials

Early modern mathematics programs were criticized by many educators because of the increased amount of reading and the more specialized vocabulary. In a study conducted by Smith and Heddens,[1] it was found that experimental mathematics materials contained readability levels too high for the students for whom the materials were intended. By applying readability formulas to

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[1]Kenneth Smith and James W. Heddens, "The Readability of Experimental Mathematical Materials," The Arithmetic Teacher, 11:491-94, October, 1964.

experimental primary and intermediate materials, the researchers found that in general (1) experimental mathematics materials were written in such a way that the readability levels were above the reading level of students using the materials, (2) even though certain parts were readable for the students, other parts were beyond the appropriate readability levels, and (3) the readability levels of the experimental mathematics materials do not appear to increase with the assigned grade levels. Experimental mathematics materials, such as those referred to above, were the forerunners of the current modern mathematics programs.

The "first generation" modern mathematics textbooks have been used in the schools for approximately ten years. As the textbook companies relied heavily on the experimental mathematics materials, many of the imperfections were incorporated into the textbooks. Johnson's[1] study conducted on early modern mathematics textbooks found that the readability level fluctuated from publisher to publisher within the same grade level. Three commercial textbooks were studied and the readability level of grade seven textbooks ranged from a grade level readability of 7.5 to 9.0. The textbooks for grades eight

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[1]Donovan Johnson, "The Readability of Mathematics Books," The Mathematics Teacher, 50:109-10, February, 1957.

and nine did not show such a wide range of variability.

In a recent study conducted by Smith and Heddens,[1] it was reported that textbook selection committees must consider two factors when judging the readability of a modern mathematics textbook. These factors are (1) the reading level of students who will be using the material and (2) the reading level of the material. The researchers applied readability formulas to primary and intermediate mathematics materials and reached the following conclusions: (1) the readability level of selected commercial texts seemed to be generally above the assigned grade level; (2) there seemed to be considerable variation of readability level among the textbooks considered; (3) the variation within each textbook indicated that some portions of the texts should be comprehended by most students, while other portions of the same text were written on a relatively difficult level. The researchers commented that the placement of material was not logical according to level of readability, that is, the readability level did not get progressively more difficult in the sequence of the units.

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[1]Kenneth Smith and James W. Heddens, "The Readability of Elementary Mathematics Books," The Arithmetic Teacher, 11:'67-68, November, 1964.

Reading Level of Students

The previous section concerned itself with the readability of the mathematics material. This section will be concerned with the reading problems of the students and how this affects success in mathematics.

Through various methods of grouping the students, educators hope to achieve more uniformity within given classes. Under such a situation, Balow[1] set up a project to study reading and computation ability as they affected problem solving. His study was designed to determine (1) if level of general reading ability was significantly associated with problem-solving ability, (2) if level of computation skill was significantly associated with problem-solving ability, and (3) if a high level of ability in one of these areas would compensate for a low level of ability in the other. The students in this project were classified according to level of computation ability and level of reading ability. Upon completion of the study, the following conclusions were reached: (1) when IQ was controlled, general reading ability did have an effect on problem-solving ability; (2) when IQ was not controlled, much of the apparent relationship between

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[1]Irving H. Balow, "Reading and Computation Ability as Determinants of Problem-Solving," The Arithmetic Teacher, 11:18-22, January, 1964.

reading ability and problem-solving ability resulted from the high correlation of each of these factors with IQ; (3) when IQ was controlled, the degree of relationship between reading and problem solving was drastically reduced; (4) when the effect of IQ was controlled, computation ability did have a significant effect on problem-solving ability; (5) there seemed to be a lack of interaction among all factors. This may suggest that, for a given level of computation ability, problem solving increases as reading ability increases, and that for any given level of reading ability, problem-solving ability increases as computation ability increases. This study pointed out that computation ability and reading ability are important factors to a child's problem-solving ability.

The one type of problem in mathematics that gives the greatest difficulty is the so-called word problem. The student is expected to "translate" the word problem to equation to solution. A study conducted by Call and Wiggin[1] considered the task of solving word problems. They attempted to determine if special reading skills, properly taught, would help students do a better job of solving word problems. The study was set up by a reading

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[1]R. J. Call and N. A. Wiggin, "Reading and Mathematics," The Mathematics Teacher, 59:149-57, February, 1966.

teacher and a mathematics teacher. Each of them would teach a unit in second year algebra that centered on solving word problems. The mathematics teacher taught mainly for the concepts and did very little with reading skills. The reading teacher, knowing very little about algebra, taught the unit from the standpoint of development of reading skills. These skills included learning meaning of words and translating the words into mathematical symbols. In results reported by Call and Wiggin, it was found that there was some merit in teaching special reading skills for the solution of mathematical problems. Their conclusions included the following: (1) even very good readers, as measured by the Cooperative Reading Test, have difficulty in the interpretation of the kind of reading found in word problems; (2) part of the difficulty which teachers encounter in teaching mathematics comes from a special kind of reading disability which does not appear on standard measuring instruments; (3) part of the difficulty which teachers encounter in the teaching of mathematics is that they are not equipped to teach reading; (4) if by teaching reading, instead of mathematics, better results can be obtained, it seems reasonable to infer that the competent mathematics teacher might get considerably better results if he were trained to teach reading of the kind encountered in mathematics

problems.

Another study that basically agrees with the findings of Call and Wiggin was conducted by Eagle[1] in the late 1940's. He too stressed the fact that the teacher of mathematics must teach the special reading skills needed in mathematics. It was interesting to note that even though twenty years separate the two studies, the need for mathematics teachers to teach special reading skills is still indicated. Eagle's study was different, however, in that he studied the speed of the reader and general comprehension of the material read. His findings included the following: (1) the positive correlation of general reading comprehension with success in mathematics appeared to be largely associated with mental age; (2) reading speed in relation to success in mathematics revealed that slow readers tended to be poor mathematics students, students of average ability tended to be slow readers and yet seemed to do quite well in mathematics, and students with above average mental age tended to excel in mathematics; (3) mathematics vocabulary appeared to be very important to success in mathematics; (4) students tended to not be realistic in their approach to

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[1]Edwin Eagle, "The Relationship of Certain Reading Abilities to Success in Mathematics," The Mathematics Teacher, 41:175-79, April, 1948.

solving word problems because they attempted to go from sentence to solution without using intermediate steps such as data tables, diagrams, and graphs before setting up the final equations. Eagle directly and indirectly suggested that the students must have instruction in reading as well as in mathematics.

In a study that was directly concerned with reading levels, Grace Bentall[1] tried to determine critical levels of reading ability for high school students. She attempted to answer three questions: (1) Is there a specific level of reading as measured by standardized tests below which academic success at the secondary school level is unlikely? (2) Is it crucial that a student maintain a good general reading ability in order to achieve success in basic ninth and eleventh-grade subjects? (3) How handicapped in academic achievement is an eleventh-grade student reading at ninth-grade level when compared to a ninth-grade student reading at seventh-grade level?

The findings showed that the percentage of successful students increased with reading proficiency

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[1]Grace Bentall, "Determination of Critical Levels of Reading Ability for High School Students as Measured by Course Marks and Achievement Test Results," (Ed.D. thesis, University of Oregon, 1961), Dissertation Abstracts, 22:1458-59.

and that the ninth-grade students with a seventh-grade reading level had more difficulty in mathematics and science than they had in English and social studies. An attempt to correlate teacher grades, reading scores, achievement scores, and intelligence scores showed a positive but low positive correlation. The low correlation, the researcher felt, indicated that teacher grades were influenced by other factors. In the eleventh grade, an eleventh grade reading level seemed to correspond to success in all subjects. However, passing could occur even though the reading level was as low as seventh grade in some subjects. Bentall concluded that there was a relationship between general reading proficiency and success in school but that reading ability was not the only factor to be considered in successful academic achievement. She also felt that reading skills needed for a particular subject were the responsibility of the teacher in that subject area.

Predicting Success

The writer many times has wished for a single predictor of success in mathematics. In this sense, success in mathematics would mean a passing grade given by the teacher.

In a study conducted by Carlin[1], prediction of success in vocational high school was attempted on the basis of intelligence, reading, and arithmetic scores from achievement tests. The study was designed so as to predict success in automotive, electrical, and wood-working courses in four vocational high schools in New York. Cumulative records of 906 tenth-grade boys were analyzed to see if there were statistical differences between means of graduates and drop-outs. Critical scores were secured for reading, intelligence, and arithmetic. Correlation coefficients were calculated to analyze the effectiveness of the prediction. The researcher found that (1) differences between mean reading scores for the two groups were significant for the electrical trades and for those categories which combined different trades; (2) differences between mean arithmetic scores for the two groups were significant for all groups. Carlin concluded that the critical arithmetic score was the best individual predictor of success, the critical intelligence score the second best predictor of success, and the critical reading score the poorest predictor of success.

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[1]Francis X. Carlin, "Intelligence, Reading and Arithmetic Scores as Predictors of Success in Selected Vocational High Schools," (Doctoral dissertation, Fordham University, New York, 1962), Dissertation Abstracts, 23:1241.

PROCEDURE USED IN STUDY

The writer decided to secure reading scores and mathematics scores to be used for the study. Such scores were available as part of the achievement test results given by the school system. The test used was the Pupil Record of Educational Progress (PREP) developed by Science Research Associates. The achievement test battery was given to all students in the school in which the writer was teaching. However, only scores obtained by ninth-grade students were used for this study. The test was given in October, 1966, and the results were made available in February, 1967. There were scores for 184 students available for use.

Description of Test

The PREP test is a battery of four separate achievement tests, each of which measures abilities important for school success. Major educational areas tested were English, mathematics, social studies, and science. Results for each of these four areas were reported plus a score for reading and a composite score which summarized the scores of the four areas tested. This composite score is considered an index of the pupil's total educational progress to date. The composite score is considered to be the best predictor of success in high

school or college.[1] Results of the tests were reported to the students as percentiles and as stanines.

The writer felt that an achievement test which stressed reading in the mathematics section was desirable for purposes of this study. Such is the case with the PREP test. In fact, a reviewer of this test in the Sixth Mental Measurements Yearbook stated:

> After perusing the test booklet itself, it is easy to see that the test is highly verbal and very dependent on reading skills. The sections dealing with mathematics, social studies, and science are heavily weighted along verbal lines with lengthy word problems which appear to make these tests more reading comprehension than mathematics or science achievement tests per se.[2]

The reviewer was pointing out the above as a possible weakness of the test.

Treatment of the Data

The data collected as test scores were treated in three separate ways in order to obtain answers to the questions stated earlier in this paper. These questions were concerned with the relationship of the reading and mathematics scores on the PREP test, the nature of the

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[1]Pupil Record of Educational Progress General Manual, Science Research Associates, Inc. (Chicago, Illinois, 1961), p. 1.

[2]Oscar Krisen Buros, The Sixth Mental Measurements Yearbook (Highland Park, New Jersey: The Gryphon Press, 1965), p. 20.

relationship between teacher grades in mathematics and mathematics, reading, and composite scores on the PREP test, and the interaction between sex of the student and mathematics, reading, and composite scores on the PREP test. Also considered was the interaction among the mathematics, reading, and composite scores on the PREP test.

In the first treatment of the data, all scores for mathematics and reading were ranked with the highest scores ranked first and lowest scores ranked last. All scores were listed as percentile scores and were used in forming the ranking. This procedure is acceptable according to Arkin and Colton[1] as set forth in their book, Statistical Methods.

After ranking both sets of percentile scores in this manner, each student's rank in reading and mathematics was obtained. The difference of the two ranks was found for each student. Then the differences were squared and the sum of the squares was tabulated. By use of Spearman's rank correlation formula, a correlation rho (ρ) was computed.[2] The computations for this statistic were carried out by the Computer Center, Kansas State University.

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[1]Herbert Arkin and Raymond R. Colton, Statistical Methods (New York: Barnes and Noble, Inc., 1962), p. 85.

[2]Ibid.

In an attempt to determine the nature of the relationship between teacher grades in mathematics and the mathematics, reading, and composite scores on the PREP test, the following procedure was used. The main idea that the writer wanted to test was whether teacher grades and the various scores showed any relationship when compared separately, that is, did students with high scores also have the high mathematics grades given by the teachers. The writer was trying to determine if one score might show enough relation to the mathematics grades so as to be used as a possible predictor of success in mathematics. A null hypothesis was set up which stated that there was no significant difference between distribution of teacher grades in mathematics and the distribution of the mathematics, reading, and composite scores on the PREP test.

The statistic used to test the hypothesis was chi square. Chi square was used because the grades were a discrete variable and the achievement test scores were continuous in nature. In his chapter dealing with chi square, McCarthy[1] presents a strong case for using chi square on this type of data.

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[1]Philip J. McCarthy, Introduction to Statistical Reasoning (New York: McGraw-Hill Book Company, Inc., 1957), p. 299-330.

A contingency table was set up for each of the following comparisons: mathematics grade versus mathematics score, mathematics grade versus reading score, and mathematics grade versus composite score. (See Appendix B.) The writer divided the percentile scale into five categories corresponding to the letter grades A, B, C, D, and F. After computing the value of χ^2 for each contingency table, a critical value of χ^2 was obtained for the .05 level of significance.[1] On the basis of the critical χ^2 values, the hypothesis was accepted or rejected for each contingency table.

Finally, the test score data were treated using analysis of variance. By use of this statistical analysis, a comparison was made between males as a group and females as a group and their test results as shown on the mathematics, reading, and composite scores on the achievement test. A comparison was also made among the various test scores. Assistance on design and computation for this area of the study was provided by the Statistical Laboratory at Kansas State University.

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[1] Murray R. Spiegel, Theory and Problems of Statistics (New York: Schaum Publishing Company, 1961), p. 345.

PRESENTATION OF RESULTS

Reading Scores Versus Mathematics Scores

The first question was concerned with the relationship of the reading scores and the mathematics scores on the PREP test. After ranking each reading and mathematics score, highest score first and lowest score last, each student's rank on reading and mathematics scores was subtracted to find the difference. Each rank difference was squared and then a correlation was computed. With the help of the Kansas State University Computer Center, each of the 184 cases was treated statistically. By use of Spearman's rank correlation formula, the correlation rho was found to be .739.[1] The t test was applied to the results and rho was found to be significant at the .05 level.[2]

Comparison Using χ^2 between Teacher Grades and Selected Test Scores

The nature of the relationship between teacher grades and reading, mathematics, and composite scores on the PREP test was explored by use of chi square (χ^2). A hypothesis, to be tested by use of χ^2, was set up. The

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[1] Arkin, loc. cit.

[2] Spiegel, op. cit., p. 189.

hypothesis stated that no significant difference existed between teacher grades in mathematics and the distribution of mathematics, reading, and composite scores on the PREP test.

Contingency tables were set up for each of the following comparisons: mathematics grade versus mathematics score on the PREP test, mathematics grade versus reading score on the PREP test, and mathematics grade versus composite score on the PREP test. Chi square values for each comparison were computed and are listed in Table I. The critical values of chi square necessary for significance at the .05 level are also given.

TABLE I

CHI SQUARE VALUES COMPUTED WHEN TEACHER GRADES IN MATHEMATICS WERE COMPARED WITH READING SCORES, MATHEMATICS SCORES, AND COMPOSITE SCORES ON THE PREP TEST

	χ^2 (Actual Computed Values)	Needed χ^2 value for signif-icance	Null Hypothesis
Mathematics grades versus reading scores	6.741	9.49*	accept
Mathematics grades versus mathematics test scores	3.133	9.49	accept
Mathematics grades versus composite scores	4.587	9.49	accept

*4 degrees of freedom at .05 level

On the basis of the computed value and critical value of chi square, the null hypothesis was accepted in all three cases. However, in the case of the mathematics grade versus the mathematics score, the value of chi square is smaller than the other two values of chi square.

Interaction of Sex of Student and Selected Test Scores

The data were treated to see whether interaction was significant between males as a group and females as a group and their test results as shown on the mathematics, reading, and composite scores on the achievement test. A comparison was also made among the various scores.

Results of analysis of variance tested at the .05 level of confidence were as follows:

1. There was no significant difference in performance by males and females after comparing composite scores on the PREP test.

2. The interaction between sex of students and reading, mathematics, and composite scores was not found to be significant.

3. A significant interaction was obtained when reading and mathematics, reading and composite, and mathematics and composite scores were compared.

SUMMARY

Results from the PREP test were statistically treated to explore the relationship of mathematics and reading scores. By use of rank difference, a correlation of .739 was obtained which showed that a significant relationship did exist between the two areas on the achievement test.

Teacher grades in mathematics, used as the measure of success in the course, were compared with percentile scores for reading, mathematics, and the composite score of the PREP test. Using chi square, no significant difference was found between the distribution of percentile scores and teacher grades at the completion of the mathematics course. The results would seem to indicate that teachers do not base grades on a single factor such as reading ability or performance.

Interaction of the various test scores and sex of the student was explored. In order to secure statistically sound results, analysis of variance was used. The findings showed that sex of students did not appear to play a significant role in performance on the PREP test. However, interaction between results of the various parts of the test did prove to be significant.

It was found that there was interaction between

mathematics and reading on the results obtained from the one application of the PREP test. The results of this study apply only to this one application and therefore cannot be generalized.

CONCLUSIONS

On the basis of the review of literature and the results of this study, the following conclusions are submitted:

1. If the goal of a school is to test for mathematical concepts and problem-solving skill, a test should be selected which does not have unnecessary verbiage in the mathematics section.

2. Secondary school teachers need to be made aware that not all needed reading skills have been taught at the elementary level. New and necessary skills must be taught at the intermediate level if students are to become good readers in each subject area.

3. The teacher should be prepared to teach those reading skills necessary and unique to mathematics because of the effect of reading on successful mathematics achievement.

4. The teachers need to be trained and oriented toward teaching reading for their subject area. In-service workshops could do a great deal to re-orient

teachers' ideas concerning reading.

5. Students preparing to become teachers need courses in reading instruction as part of their training.

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APPENDIX A

NINTH-GRADE MALE PERCENTILE SCORES
ON PREP TEST AND TEACHER GRADE

Student Number	Reading	Mathematics	Composite	Teacher Grade
1	45	41	44	B
2	95	93	97	B
3	17	19	15	F
6	88	81	82	A
8	76	53	67	C
9	32	29	26	F
10	72	75	63	C
13	86	95	95	B
14	10	34	06	C
15	54	61	47	D
18	01	08	08	D
22	24	11	15	D
25	24	34	26	D
26	88	61	84	D
28	72	68	67	A
30	23	14	14	F
32	54	61	65	C
33	04	29	02	D
34	45	81	41	C
35	59	61	53	B
39	36	57	41	D
41	64	75	72	C
42	92	57	84	B
48	83	89	84	F
49	76	78	81	B
52	64	34	47	B
53	53	57	60	C
56	85	68	82	B
59	83	72	70	C
60	64	24	41	D
62	12	14	09	D
63	98	89	98	D
64	05	14	01	F
65	36	29	31	D
69	64	91	81	C
70	32	11	22	D
71	45	91	63	B
76	90	87	99	C
77	96	81	93	C
79	16	14	09	C
80	68	75	60	D

Student Number	Reading	Mathematics	Composite	Teacher Grade
87	28	47	34	D
89	90	57	79	B
90	95	81	95	C
91	59	34	53	C
94	88	68	84	B
97	45	14	34	D
99	90	34	65	D
100	98	84	95	B
102	50	57	58	F
103	76	47	65	D
104	80	57	67	F
105	24	14	12	F
106	76	61	67	B
107	95	91	93	C
108	83	29	70	D
109	23	29	22	B
114	54	94	70	C
118	50	41	41	D
121	54	34	55	C
123	88	75	86	A
127	83	61	77	D
129	50	05	24	D
130	72	65	75	C
131	32	98	60	D
136	94	96	97	B
138	20	29	20	D
139	88	57	79	A
140	05	24	09	D
141	12	29	10	C
142	40	41	20	F
146	15	24	19	F
148	08	11	06	D
149	46	11	28	D
150	20	08	08	F
151	28	47	34	F
153	76	96	82	A
156	50	53	58	B
160	83	61	81	A
161	08	53	12	C
163	32	24	26	D
164	80	57	65	B
165	32	24	20	D
166	20	24	24	D
167	98	98	99	A
168	80	78	81	C
172	64	68	63	D

Student Number	Reading	Mathematics	Composite	Teacher Grade
173	23	34	14	B
175	15	02	04	F
176	50	34	47	F
180	20	41	10	D
182	98	96	93	A

NINTH-GRADE FEMALE PERCENTILE SCORES
ON PREP TEST AND TEACHER GRADE

Student Number	Reading	Mathematics	Composite	Teacher Grade
4	71	57	63	A
5	50	24	47	A
7	83	47	77	D
11	42	53	41	C
12	32	14	28	D
16	68	61	63	C
17	42	61	41	B
19	80	47	65	C
20	83	72	79	D
21	85	53	77	D
23	27	14	24	F
24	68	53	65	B
27	94	64	89	C
29	28	29	31	D
31	40	47	47	D
36	90	68	89	D
37	28	68	39	B
38	88	91	93	D
40	35	34	34	D
43	20	02	17	F
44	54	75	70	C
45	10	02	03	C
46	60	47	58	B
47	15	24	14	D
50	05	34	07	F
51	06	19	08	F
54	93	47	96	D
55	15	11	17	D
57	50	98	70	B
58	98	95	99	B
61	05	11	09	D
66	88	41	84	C
67	97	87	98	A
68	28	03	20	C
72	50	47	60	D
73	85	87	89	B
74	20	29	28	C
75	64	91	81	A
78	72	72	72	D
81	15	29	31	C
82	90	61	79	D

Student Number	Reading	Mathematics	Composite	Teacher Grade
83	92	81	94	A
84	59	87	70	C
85	72	57	72	C
86	88	87	89	B
88	40	14	34	D
92	32	08	19	F
93	88	84	89	C
95	90	93	91	C
96	28	57	41	D
98	64	34	58	C
101	92	72	95	C
110	36	34	31	D
111	67	41	70	D
112	42	57	58	D
113	12	11	20	F
115	45	05	24	D
116	88	84	91	B
117	83	47	77	D
119	94	97	97	B
120	72	53	65	D
122	10	41	05	D
124	68	72	72	C
125	85	53	74	B
126	88	68	82	C
128	28	11	12	C
132	72	41	67	B
133	08	19	05	C
134	45	19	37	A
135	14	41	20	F
137	76	78	79	A
143	64	68	72	D
144	54	61	58	B
145	50	61	65	B
147	09	03	06	D
152	17	19	19	C
154	64	53	65	C
155	54	81	63	B
157	50	29	47	D
158	85	61	82	D
159	92	84	91	B
162	97	96	99	A
169	54	57	53	B
170	64	47	65	B
171	76	61	70	C
174	76	47	67	D
177	10	53	22	F

Student Number	Reading	Mathematics	Composite	Teacher Grade
178	50	75	65	B
179	09	19	10	C
181	38	05	60	D
183	27	19	20	C
184	93	81	97	C

APPENDIX B

TABLE II

CONTINGENCY TABLE OF MATHEMATICS GRADES
VERSUS PREP MATHEMATICS SCORES

Categories and Grades	Expected (f_e)	Observed (f_o)	$\frac{(f_o-f_e)^2}{f_e}$
99-81 (A)	10.6	8	.638
80-61 (B)	10.6	11	.015
60-41 (C)	10.6	8	.638
40-21 (D)	10.6	15	1.827
20- 1 (F)	10.6	11	.015
Total	53	53	χ^2=3.133

TABLE III

CONTINGENCY TABLE OF MATHEMATICS GRADES VERSUS PREP READING SCORES

Categories and Grades	Expected (f_e)	Observed (f_o)	$\frac{(f_o-f_e)^2}{f_e}$
99-81 (A)	10.8	9	.300
80-61 (B)	10.8	7	1.337
60-41 (C)	10.8	9	.300
40-21 (D)	10.8	18	4.800
20- 1 (F)	10.8	11	.004
Total	54	54	χ^2=6.741

TABLE IV

CONTINGENCY TABLE OF MATHEMATICS GRADES
VERSUS PREP COMPOSITE SCORES

Categories and Grades	Expected (f_e)	Observed (f_o)	$\frac{(f_o-f_e)^2}{f_e}$
99-81 (A)	11.6	10	.221
80-61 (B)	11.6	13	.169
60-41 (C)	11.6	6	2.703
40-21 (D)	11.6	15	.997
20- 1 (F)	11.6	14	.497
Total	58	58	$\chi^2=4.587$

THE RELATIONSHIP BETWEEN READING AND SUCCESSFUL NINTH GRADE MATHEMATICS ACHIEVEMENT

by

HOWARD KARL STENZEL

B. S., Kansas State University, 1961

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

The problem of this study was to determine the effect of reading on successful mathematics achievement. To study this problem, the following specific questions were considered:

1. Was there any significant relationship between mathematics and reading scores as indicated on the PREP test?

2. What was the nature of the relationship among the following factors: (a) teacher grades in mathematics and the PREP mathematics score? (b) teacher grades in mathematics and the PREP reading score? (c) teacher grades in mathematics and the PREP composite score?

3. Was there any interaction among these factors: (a) sex of the student and PREP mathematics score? (b) sex of the student and PREP reading score? (c) sex of the student and PREP composite score?

4. Was there any interaction among the reading, mathematics, and composite scores?

This study was limited by the following factors: only a ninth grade class in one junior high school in Wichita was studied, and the particular socio-economic level of the school patrons was lower middle class.

The questions were studied by use of Spearman's rank correlation formula, chi square, and analysis of variance. A rank correlation was used to determine the

relationship between mathematics and reading scores on the PREP test. Chi square was used to see if there was a significant difference between the distribution of percentile scores and teacher grades. Analysis of variance was used to study the interaction of sex of student and the various test scores and the interaction of the scores themselves on the PREP test.

Results of the study were as follows: (1) there was a significant relationship between reading and mathematics, .739, at the .01 level, (2) there was no significant difference between teacher grade distribution and the distribution of percentiles, and (3) there was a significant interaction among test scores while there was no significant interaction between sex of the student and the various test scores.

On the basis of this study the writer submitted these conclusions:

1. Achievement tests should be selected that do not contain unnecessary verbiage in the mathematics section.

2. Secondary school teachers need to be made aware of reading skills necessary for their particular subject area and grade level.

3. Mathematics teachers need to be aware of special reading skills needed for successful mathematics achievement.

4. Teachers need to be trained and oriented toward teaching reading for their subject area.

5. Students preparing to become teachers could profit from courses in reading instruction as part of their training.